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Timber Harvest Affects Elk Distribution in the Blue Mountains of Oregon

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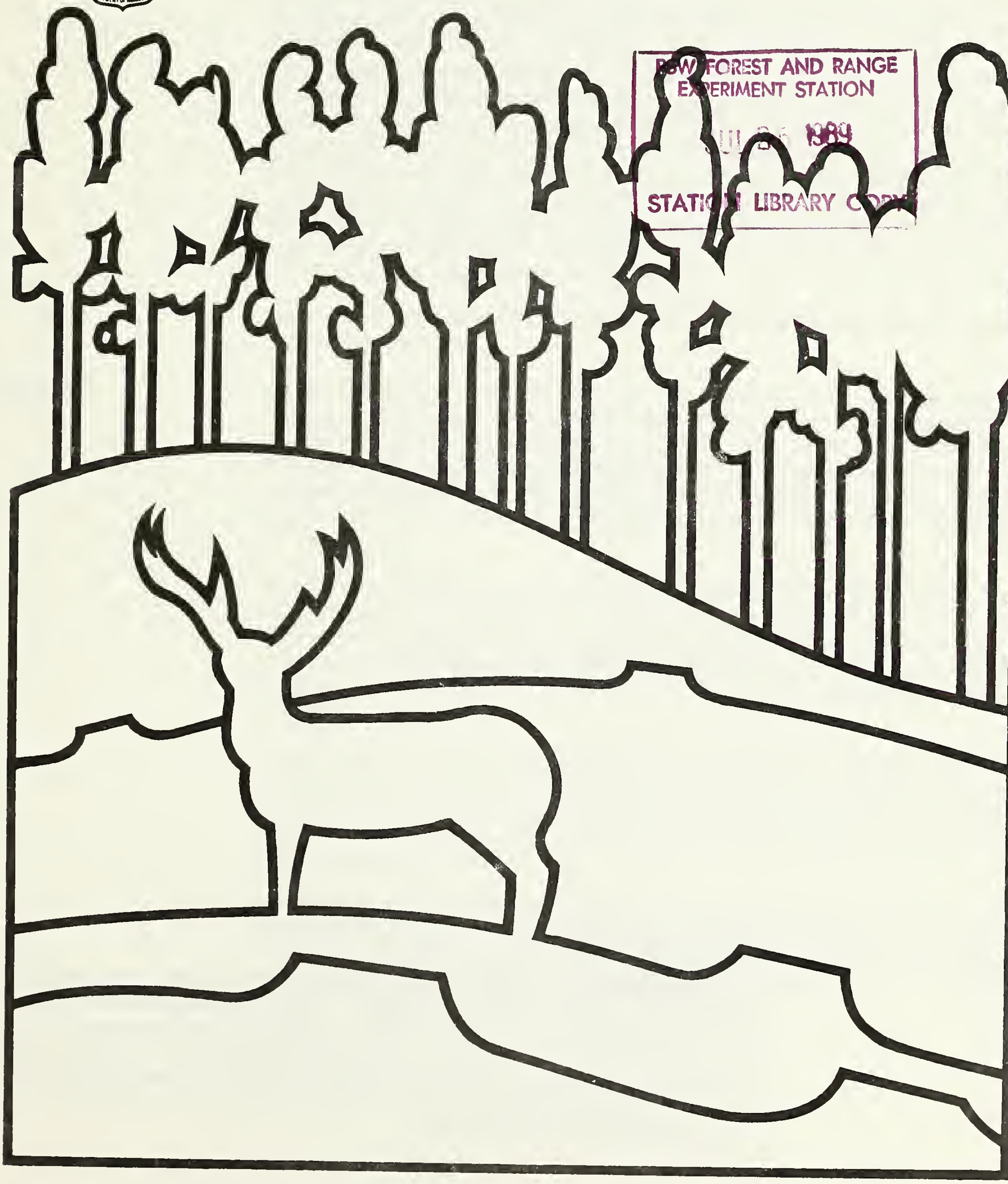

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Abstract

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A long-term study to determine the effects of several methods of timber harvest on the distribution of Rocky Mountain elk (*Cervus elaphus nelsoni*) was begun in the early 1970's in the Blue Mountains of northeastern Oregon. The study area was an upper slope spruce-fir type with harvest designed to compare changes in elk use, as measured by pellet-group densities under small-patch or large-block clearcuts, partial cuts, and uncut controls. Results showed prescribed logging practices in spruce-fir forests improved forage and habitat diversity for elk. Overall use by elk increased three and one-half times over that of use before logging. By the 5th year after disturbance, however, elk use declined to near former levels. Patch clearcut logging resulted in greater elk use than partial cutting. Uncut adjacent timber stands were also important as cover for elk that used the clearcuts. Grass and legume seeding did not significantly enhance elk use of clearcuts.

Keywords: Rocky Mountain elk, timber harvest, spruce-fir forest, clearcuts, logging, Blue Mountains, Oregon.

Summary

Areas of study were established in spruce-fir forest types in the Blue Mountains of northeastern Oregon in 1971 to assess long-term effects of timber harvest on Rocky Mountain elk distribution. Objectives of the study were to (1) determine the difference in levels of elk use before and after timber harvest, (2) contrast changes in use among logging methods, and (3) identify habitat changes that might account for any differences found in elk use. Pellet-group densities were used to establish differences in levels of elk use.

Timber harvest areas for study were 2 large clearcut blocks, 10 small clearcut patches, and 2 partially cut stands, all of which were interspersed within adjacent uncut virgin forest. Harvest residue from clearcutting was broadcast burned and half of the units were subsequently seeded with grasses and a legume. Partially cut stands had large slash removed by yarding and small slash hand piled; these stands were not seeded.

Results showed that timber harvesting had a net effect of increasing overall elk use by three and one half times over densities found during the 5 pretreatment years. By the 5th year after logging, elk use had returned to pretreatment levels. Clearcutting resulted in greater elk use than partial cutting. Grass and legume seeding did not enhance elk use of clearcuts.

We concluded that elk increased their use of clearcuts because available forage increased after logging. Elk use of adjacent unlogged forest was also high because it afforded animals good hiding cover. Partial cuts were used least because they neither afforded good cover nor increased available forage.

Contents

Introduction

Timber harvest probably has the most dramatic effect on elk (*Cervus elaphus nelsoni*) habitat of any land management practice in the Pacific Northwest; therefore, coordination between foresters and wildlife biologists is essential for meeting both the habitat requirements of elk herds and the wood fiber needs of the forest products industry. Logging has produced both positive and negative elk response throughout Western North America (Hieb 1976). Response often depends on the type and age of forest stand, method and size of areas logged, kind of residue treatment, and time lapsed since logging (Skovlin 1982).

Logging and attendant road construction usually decrease elk use in affected areas during the period of peak human activity (Pedersen and others 1979, Ward 1976). Regardless of the timber type or region, elk use increases most often following harvest, especially in 6- to 12-hectare (ha) clearcuts, because of increased forage quantity or quality and increased edge effect (Harper 1971, Pearson 1968, Reynolds 1966).

Some investigators, however, have found that clearcutting can be detrimental to elk use depending on slash treatment, size of clearcut, or time since cutting (Garrison and Smith 1974, Lyon and Jensen 1980, Marcum 1976). Reasons for detrimental effects have been lack of suitable hiding cover for concealment and thermal cover to ameliorate environmental extremes, limited edge, and inaccessibility of forage because of heavy slash accumulations.

This variation in findings points to the need for more regional information on the effects of timber harvest and associated activities on use patterns of elk habitat in specific forest types. An opportunity for such a study in the upper slope spruce-fir forests of the Pacific Northwest existed during the prescribed logging of the High Ridge watershed evaluation area, a barometer watershed on the Umatilla National Forest in the central Blue Mountains in northeast Oregon.

In a similar study of spruce-fir forest habitat, Reynolds (1966) found elk of the Southwest use artificial openings (clearcuts) twice as much as natural openings and that openings larger than 8 ha (160 meters [m] in diameter for circular patches) receive little use except around fringes. Similarly, elk use increases as openings become smaller than 8 ha.

The objectives of our study were to (1) determine the difference in levels of elk use before and after two methods of timber harvest in the spruce-fir forest type, (2) contrast changes between use of small-unit clearcuts (6-12 ha) with use of more extensive partial cuts and use of adjacent unharvested control areas, and (3) identify the main features of habitat change that might account for differences in use.

Study Area

The evaluation area is located near the crest of the Blue Mountains between La Grande, Oregon, and Walla Walla, Washington. In the area, a series of four subwatersheds total 225 ha on a north-sloping gentle bench between 1439 m and 1616 m elevation above sea level. Soils are well-drained silt loams 1 to 2 m deep that developed from volcanic ash deposited over an older, buried soil (Geist and Strickler 1978).

Mean annual precipitation is about 1430 millimeters (mm) equally distributed between October and May and falling mostly as snow; winter accumulations in excess of 2500 mm are not uncommon. Average monthly temperatures range from -4 °C in January to 16 °C in July with a mean annual temperature of 5 °C. Climatic and hydrologic relations for this area are reported by Fowler and others (1979).

Undisturbed Forest Communities

The densely stocked timber overstory is a mixture of grand fir (*Abies grandis* (Dougl.) Lindl.)[1] and Engelmann spruce (*Picea engelmannii* Parry ex Engelm.), with lesser amounts of subalpine fir (*Abies lasiocarpa* (Hook.) Nutt.), western larch (*Larix occidentalis* Nutt.), lodgepole pine (*Pinus contorta* Dougl. ex Loud.), and Douglas-fir (*Pseudotsuga menziesii* (Beissn.) Franco). Commonly, stand basal area exceeds 75.0 m^2 per ha and canopy cover exceeds 90 percent.

The understory is sparse and widely scattered with herbs and few, if any, shrubs or young trees. Grasses and grasslike plants are predominantly Ross sedge (*Carex rossii* Boott), pinegrass (*Calamagrostis rubescens* Buckl.), Alaska oniongrass (*Melica subulata* (Griseb.) Scribn.), and spike trisetum (*Trisetum spicatum* (L.) Richt.). Uncommon but locally abundant forbs are American adenocaulon (*Adenocaulon bicolor* Hook.), Oregon anemone (*Anemone oregana* Gray), heartleaf arnica (*Arnica cordifolia* Hook.), woods strawberry (*Fragaria vesca bracteata* (Heller) Davis), twinleaf bedstraw (*Galium bifolium* Wats.), mountain sweet-root (*Osmorhiza chilensis* H. & A.), and Fendler meadowrue (*Thalictrum fendleri* Engelm.). Uncommon woody plants include mostly Sitka alder (*Alnus sinuata* (Regel) Rydb.), Utah honeysuckle (*Lonicera utahensis* Wats.), common princes-pine (*Chimaphila umbellata* (L.) Bart.), sidebells pyrola (*Pyrola secunda* L.), and twinflower (*Linnaea borealis longiflora* Torr.).

Seral Forest Communities

Forest disturbance from logging or fire creates a favorable environment for the establishment and growth of a variety of grasses, forbs, and shrubs. These seral species usually develop from dormant seed buried in the litter and soil (Strickler and Edgerton 1976) and from seed transported to the area from other seral communities by wind, birds, animals, and humans. Abundant seral species include Ross sedge, Columbia brome (*Bromus vulgaris* (Hook.) Shear), bull thistle (*Cirsium vulgare* (Savi) Airy-Shaw), willowweeds (*Epilobium* spp.), heartleaf arnica, mountain pea (*Thermopsis montanas* Nutt.), big whortleberry (*Vaccinium membranaceum* Dougl. ex Hook), sticky currant (*Ribes viscosissimum* Pursh), and elderberry (*Sambucus* spp.). Tree regeneration consists of both planted seedlings and seedlings established from the seed of adjoining stands.

Elk Population

Elk in the Blue Mountains have been talked about and studied by biologists and hunters for many years (Bailey 1936). The narrow crest of the Blue Mountains in this High Ridge section is flanked by abundant winter range, but summer forage is in relatively short supply. Spring migration begins in March, and cow elk are calving on the summer range by mid-May. After 7 months on summer range, they return to adjacent foothill winter ranges as snows accumulate on the summit in late November. Populations have shown slow but steady increases since midcentury.

Harvest Treatments

The evaluation area was developed to document the effect of timber harvest treatment on hydrologic parameters. Five cutting units and an unharvested control were established (fig.1). Roads were constructed during midsummer 1975, and the harvest treatments were completed between July and September 1976.

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[1] Scientific and common names of plants are from Garrison and others (1976).

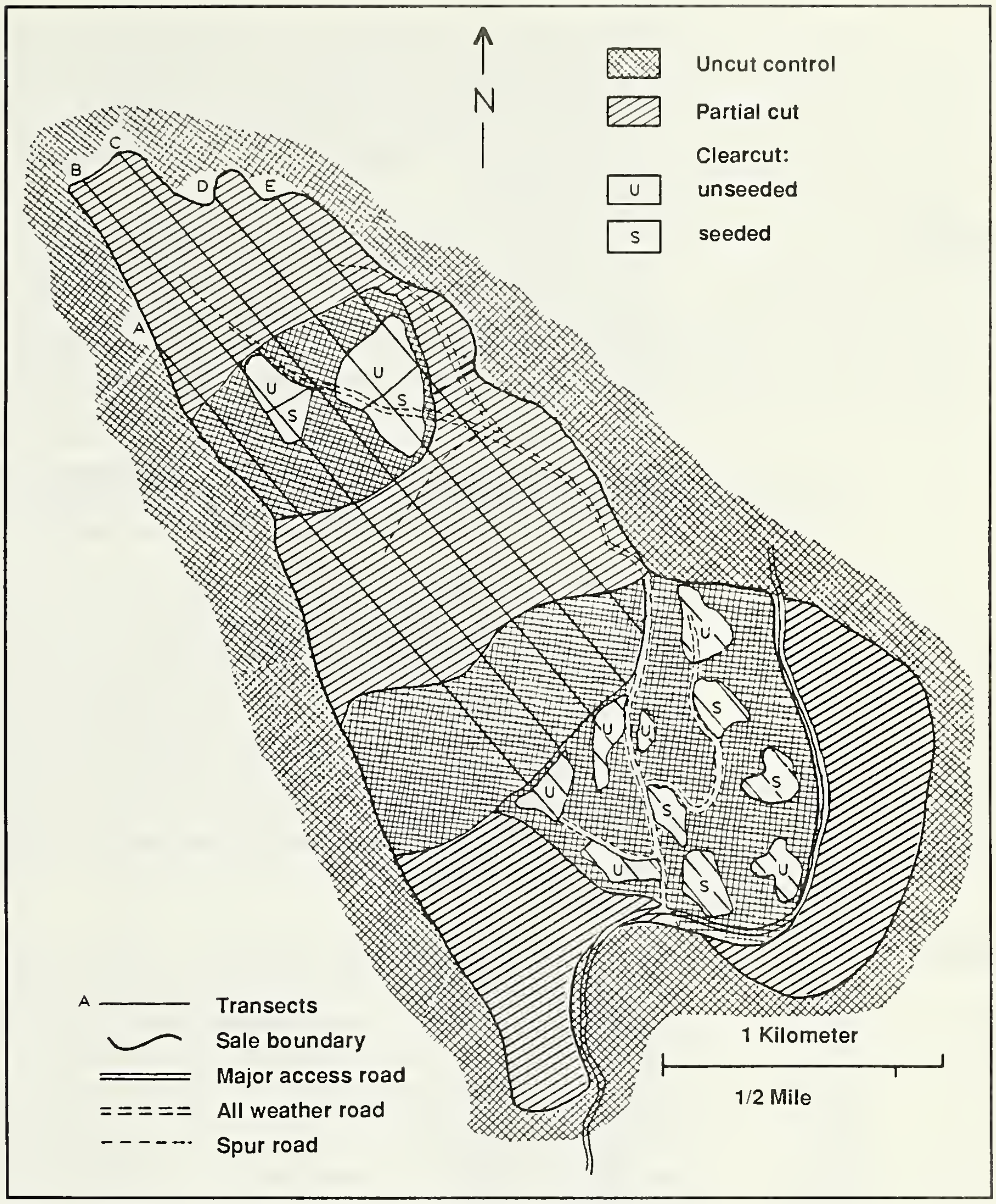

Figure 1—Diagram of the High Ridge evaluation area showing size and shape of cutting units and control areas, seeded and unseeded portions, and location of pellet transects.

In the two partially cut treatments, 50 percent of the stand volume was harvested. Large slash was yarded, and small slash was piled by hand with no further treatment. The two clearcut treatments differed in size of individual harvest units. One contained 2 large clearcut blocks of 3.6 and 8.5 ha, and the other contained 10 smaller units from 0.8 to 2.6 ha. These treatments removed 43 and 22 percent of the stand volumes in the respective watersheds. In late September 1976, slash within the units was machine piled and burned; unburned slash was machine scattered.

In early October, one-half of each of the large block clearcuts and five of the small patch clearcuts were seeded by hand with domestic grasses and a legume for erosion control studies.[2] The remainder of the clearcuts were left unseeded for this study. All clearcuts were planted by hand with conifer seedlings during spring of the 1st year after logging. No treatments were permitted within the unharvested control area during the study.

Methods

Pellet Group Sampling

Measurement of the yearly accumulated pellet groups defecated by elk was chosen for comparing animal response to treatments. Before application of treatments, the study area was gridded with multiple random-start transects located 160 m apart. Permanent pellet-group plots, 3.96 m by 20.1 m (0.008 ha), were spaced at 80.5-m intervals along these transects. Intermediate transects 80.5 m apart were established through the large clearcut blocks, and a similar grid of transects 40.2 m apart were used to sample the smaller clearcuts. The plots were established in the summer of 1971. Beginning in 1972, plots were counted and cleared of pellet groups immediately after snowmelt each spring. Counts were taken annually for 5 years before timber harvest and for each of the 5 years after timber harvest.

Managers and researchers have long used group counts of pellets as a valuable wildlife technique (Neff 1968). More recently, however, controversy has developed among researchers as to whether the density of pellet groups is an accurate linear index to animal time-space distribution (use). Because animals may select different habitats for different activities, variable defecation rates may result in each habitat. As a result, a poor correlation may exist between the distribution of pellet groups and actual observed habitat use as has been reported for deer by Collins and Urness (1981). Conversely, White (1960) and Bennett and others (1940) report good agreement between pellet-group distribution and population observations. We believe that pellet-group densities provided the best available measure of elk use in the altered habitats of the study area.

Analysis

The treatment design permitted analysis of variance (ANOVA) for determining differences in use (pellet-group densities) among cutting method. Pretreatment densities for an average of 5 years were subtracted from the five annual posttreatment densities. The analysis of the effect of the treatments was then based on the yearly difference. We recognized two problems in the interpretation of these analyses: (1) uncut controls were measured between partial cuts and clearcuts and (2) clearcuts were different sizes; small patch cuts ranged from 0.8 ha to 2.6 ha; whereas, block cuts were 3.6 ha and 8.5 ha. Location and size of the areas may have influenced habitat use by elk.

Differences in pellet densities between seeded and unseeded portions of clearcuts were compared with unpaired t-tests.

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[2] Seeding consisted of hard sheep fescue (*Festuca ovina duriuscula* L.), 1.1 kg per ha; intermediate wheatgrass (*Agropyron intermedium* (Host.) Beauv.), 0.9 kg per ha; orchardgrass (*Dactylis glomerata* L.), 1.3 kg per ha; and white clover (*Trifolium repens* L.), 0.56 kg per ha, all of which were seeded by hand in October immediately following slash burning.

Results

Timber harvesting had a net 5-year effect of increasing overall group densities of elk pellets about three and one-half times over the group densities and during the 4 pretreatment years (fig. 2). No trends or differences in elk use were apparent in the study area during pretreatment years.[3] Total elk use during the 1st year after logging was higher than that during the 2d or 3d. By the 4th year elk use had nearly returned to preharvest levels. Although elk use did increase considerably after logging, no significant differences in use were found between treatments, largely because year-to-year variation was high, masking differences among cutting methods.

Elk use was somewhat higher in the clearcut units, with nearly seven times more groups counted after harvest than before harvest. The large block clearcuts consistently contained about twice as many pellet groups as the small patch clearcuts. Size, however, was not the only contributing factor.

[3] Annual herd unit trend counts by the Oregon Department of Fish and Wildlife (ODF&W) indicated a modest population increase over the entire 10-year study period (personal communication, ODF&W).

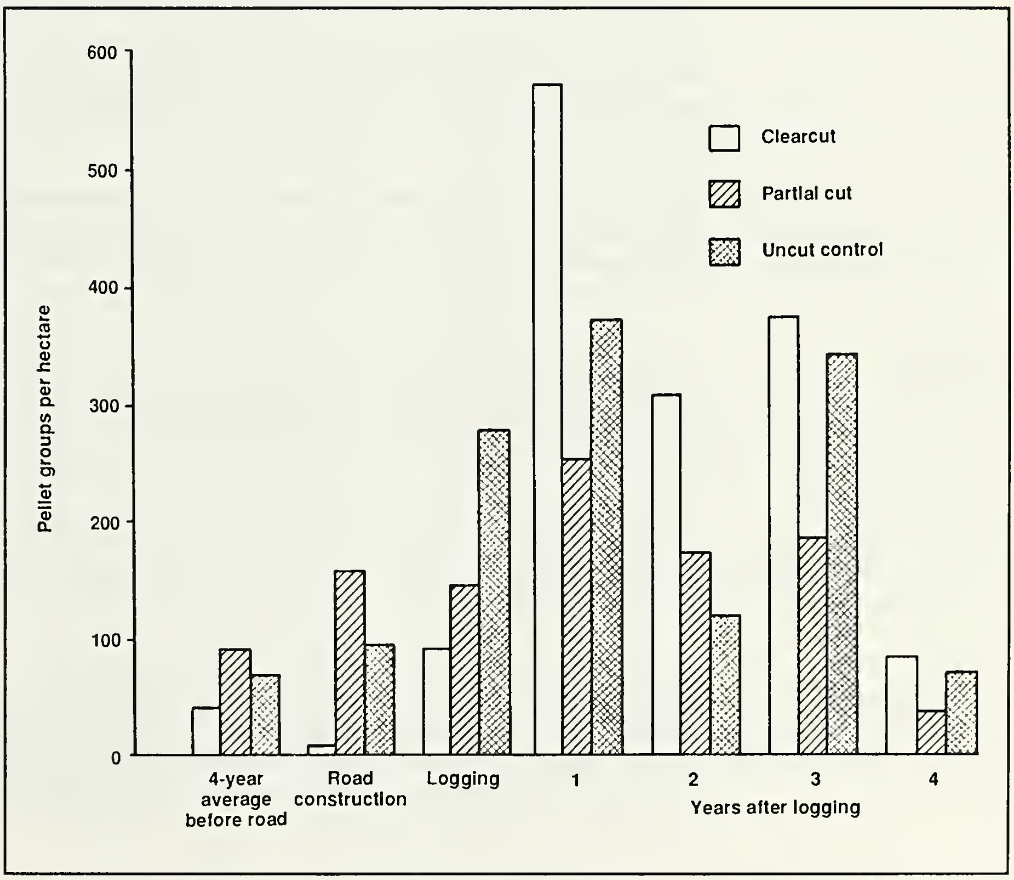

Figure 2—Comparative elk use, expressed as pellet-group densities, of treatment and control areas in the High Ridge evaluation area before harvest, during road construction and harvest, and after all treatments.

Table 1—Densities of pellet groups in seeded and unseeded portions of clearcuts in the High Ridge evaluation area

	Preharvest year					Postharvest year				
Treatment	1	2	3	4	5	1	2	3	4	5
	Groups per hectare									
Large blocks:										
Seeded	77	21	10	0	18	237	589	427	324	38
Unseeded	0	0	0	0	16	151	851	494	425	41
Overall	44	14	7	0	17	203	697	455	364	38
Small patches:										
Seeded	119	90	59	18	28	77	418	262	247	47
Unseeded	75	48	62	54	0	36	301	124	330	131
Overall	101	73	60	36	17	59	371	205	280	79

Overall elk use of the two partially cut areas increased about twofold over that before harvest. Use within the partial cuts was slightly less than in the two uncut controls. Pellet densities in the controls were three and one-half times greater after harvest than before.

Elk use in the control areas was highest, relative to that in clearcuts and partial cuts, during the year of logging and lowest in the 2d year, which was after both logging and the heaviest winter snowfall of the 10-year study. During that year, elk use was limited to the 6 snow-free months.

Grass-legume seeding did not have a profound overall effect on use by elk (table 1). Elk showed a slight preference for seeded units over unseeded units during the first 3 years after logging and seeding. During the 4th and 5th years, however, use decreased in the seeded portions and increased somewhat on the unseeded portions.

Discussion

Timber harvest increased the abundance and variety of forage available, particularly in the clearcuts, while surrounding unlogged stands provided suitable habitat for resting and concealment. Clearcutting and slash burning created favorable environments for the aggressive establishment and growth of numerous early seral species.

Partial cutting also increased forage, but canopy reduction and soil disturbance were not sufficient to promote development of many preferred seral forage species. Coupled with reduced cover, these stands were less attractive as habitat than either clearcuts or uncut stands.

These findings are similar to those observed by Edgerton (1972) in mixed conifer stands of the northern Blue Mountains. He also found clearcutting results in higher elk use than in adjacent uncut stands but that partial cutting results in less use than uncut stands. Edgerton postulated that clearcuts are more attractive to elk than uncut stands because of a variety and abundance of preferred forage and that lower use in partial cuts is probably because of a lack of hiding and thermal cover.

Although uncut stands lack forage, they provide a comparatively stable thermal environment for elk (Edgerton and McConnell 1976). Cool midday temperatures were likely the main attraction during hot summer days. During cold and stormy periods in early spring, late fall, and early winter, elk undoubtedly also sought shelter to minimize body heat loss in the unlogged stands.

Elk also used unlogged stands as hiding cover during hunting seasons and other periods of occasional high human activity. Use of the unlogged stands was especially pronounced during the summer of logging and the following year of high-level forest management activity. Road construction and presale layout projects in the year before logging appeared to influence habitat use. That year, human disturbance was mostly concentrated in and about planned clearcuts and not in partial cuts and controls. Consequently, elk use was low in planned clearcuts and relatively high in the yet unlogged partial cuts and adjacent control areas. On an adjacent elk summer range with mixed forest and natural openings, Pedersen and others (1979) found that radio-collared elk also avoided the timber harvest areas during active roading and logging.

Seeding

Greater elk use of grass- and legume-seeded clearcuts in early years may have resulted from the rapid establishment of domestic species before native species could reoccupy the site. Nearby studies (Korfhage and others 1980) have shown seeded grass from clearcuts to be a frequent item in the elk's summer diet. The reason elk preference shifted later to unseeded units probably related to differences in development of preferred species on the seeded and unseeded clearcuts. At the end of the second season after seeding, Helvey and Fowler (1979) found seeded species provided four times greater cover than native species in seeded clearcuts. On unseeded areas, however, native species provided two times more cover than on seeded areas, indicating that seeded species suppressed establishment of native species. Because native species such as sedges (*Carex*) and certain shrubs and forbs are highly preferred by elk on summer range (Korfhage and others 1980) and these species were not suppressed in the unseeded units, they probably flourished in unseeded units by the 4th and 5th years, thus providing greater attraction for elk.

Management Implications

Comparisons of timber harvest methods in spruce-fir forest types in the central Rocky Mountains (Alexander 1977) have shown clearcutting of small patches to be highly economical and to produce the greatest increase in water yield without undue loss in water quality; greater wildlife habitat diversity was also a positive feature of this harvest strategy.

Partial cuts in our study did not provide the increase in forage available for elk that clearcuts provided nor did they provide the protective cover of the adjacent uncut stands. Elk use of partial cuts may have been even lower without the presence of clearcuts and cover areas in the study area.

Like clearcutting, shelterwood harvesting is a silvicultural option sometimes practiced in spruce-fir forest types. Initial succession and vegetation response is very similar to that after clearcutting. We would, therefore, expect elk to respond essentially the same way as reported for clearcuts in this study.

The pattern of elk use documented by our study is probably characteristic of managed forest habitats throughout the Blue Mountains (Thomas 1979). Elk are attracted by improved forage conditions in newly logged clearcuts but rely on adjacent unlogged habitats for concealment and thermal cover. As the new forest develops and begins to assume dominance, usually in 10 to 25 years, preferred forage plants become less abundant. Elk, then, are attracted to nearby cutting areas where secondary succession has more recently been initiated.

Using this knowledge, land managers and biologists have the opportunity to predict and, albeit crudely, to plan the effect of timber harvest and related activities on the distribution of elk.

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